

OF INTEREST TO TEACHERS  
BIOLOGY IN HIGH SCHOOLS\*

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The word "biology" is here used to include botany, zoölogy, and physiology, under one term. These three sciences are closely interrelated: it is recognized that zoölogy and physiology are best taught together; so also it may be noted that the course called "general biology" embraces an alternate comparison between vegetable and animal forms. Zoölogy and botany may advantageously be studied thus intermixed, because, first, the chemical and physical forces are common to all the kingdoms of nature; second, because of the ecological interactions between the two organic kingdoms as illustrated by parasitism, symbiosis, fertilization of flowers by insects, food relations, etc.; thirdly, seasonal changes affect both plant and animal life, calling for a study of both kingdoms throughout the year.

On the other hand, from the systematic point of view, it is as convenient to take botany and zoölogy separately and successively, as it is to consider the classes of animals in definite order. There are other reasons in favor of studying a particular branch of biology during a definite period.

There should be no question as to the propriety of including biology in the high school curriculum. As one at least of the three branches of biology has been taught in a large proportion of the high schools for an indefinite period of years, we should not be charged with trying to crowd a "new fangled fad" into an already overcrowded curriculum.

So far as biology replaces physiology, botany, and zoölogy and is given only the time of a single study, the result may be to reduce the time given to biological study, a reduction to be deplored, for never even under the most favorable circumstances, have these subjects been granted their due proportion of time in comparison with other subjects. The three R's are taught *daily* from the kindergarten to the college sophomore year, yet the fear is often expressed that the fundamentals of education are endangered

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by the encroachments of such hobbies of the faddists as "nature-study," "agriculture," "biology," and an indefinite number of other "ologies." So far as this fear is well founded the attempt to replace three of the "ologies" by a single one, should be welcomed. Yet this does not seem to meet the pedagogic ideals of educators on the one hand, nor of business men on the other. These are gravely asking what benefit comes from a study of natural science? Does it induce to efficiency? Does it confer mental training and power? Does it equip the student with the tools whereby he can win success in business competition? And if natural science be admitted into the general curriculum, why *biology*, rather than physics or chemistry? Is not biology a technical subject fit only for those who are to enter the medical profession? Do not physics and chemistry underlie biology whereas no knowledge of biology is needed for the study of the physical sciences?

It is not my purpose to answer these questions, they have been ably answered by others, such as Lloyd, Bigelow, and Hodge. We are convinced that biology should form an essential part of a common school education and we call attention to tendencies operating against this.

College entrance requirements determine to a large degree the contents of the high school curriculum. But the college has practically abandoned the old time "general course" which included a considerable list of the natural sciences. The present ideal is the "technical" course, fitting the graduate for a particular business, and including only the studies that most directly bear on the aim of the course. Biology is retained practically only in the courses leading to medicine or to agriculture. Physics and chemistry underlie most technical courses, therefore the college requires the physical rather than the biological sciences as preparatory for entrance. In regard to the classical and literary courses, the so-called "culture" courses, the case is no better, for in these, the "sciences" are offered as "electives" that may or may not be chosen. The classical courses are in fact as highly technical as any course by specializing in language-training, so useful to preachers and lawyers. Conditions that

favor the special course, operate also in the high school. There are the "classical" and the "scientific" courses, preparatory for college. As the majority of its graduates do not enter college, it is urged that such should not be compelled to take these preparatory courses, but for them should be provided suitable courses fitting for business, teaching, etc.; the ideal is the *special*, rather than the *general* course. In a normal course some biological study has generally been included, not as an essential educational element, but because the teacher anticipates the possibility that he may be required to teach the subject. In the training of teachers for special lines, biology is naturally excluded; and unless biology be established as an essential part of secondary education, there will be a decreasing number of general teachers prepared to teach this subject. Perhaps most of the educated men of yesterday had studied some biology though but a mere smattering of antiquated rudiments; to-day, very few of our educated men have received even that much. This is the more remarkable in view of the recent wonderful development of this science, and the increasing rate at which biological problems are pressing into public interest in directions both practical and theoretical. The air is full of biologic lore though mostly false, inadequate, and distorted. Our newspapers have it in the editorial, in the advertizing, and the reportorial column. A biological basis underlies half the utterances of the pulpit. Questions of public policy involving ventilation, disinfection, quarantine, pure food, alcohol, athletics, protection of birds, and of forests, destruction of insects, eradication of tuberculosis, etc. envelope us as an atmosphere; yet the principles involved, are considered expert knowledge, just as in olden days the average man had to hire his reading and writing done for him.

If any one doubts the statement that our educational ideals are against including biology as an essential of a general education, let him try to have biology substituted for even so small a part as one tenth of the time devoted to Mathematics, English, Greek, Latin, or German, in our educational institutions. The time given to the so-called "humanities," has been increased by borrowing from scientific subjects, and often actually excluding biology.

While this retrograde movement has progressed in the higher education, a counter movement has arisen for the introduction of "nature study" into the earlier years of the common schools. Biology necessarily is the principal content of Nature Study. If such study does not interfere with the preparation to meet the requirements for promotion to higher grades, there is hope for the success of the movement, and so in time, everybody will be given a kindergarten knowledge of biology. But is this amount of knowledge sufficient for a full and perfect living?

It is a trite saying that education has a two-fold aim, viz.: the training of faculties, and the acquisition of truth. We have other faculties than those involved in the three R's; and there is truth outside the so-called "humanities." The objective world of nature incarnates at least one half of truth.

Nature is not a disagreeable prison house to be shunned but it is the handiwork of the Almighty—the macrocosm out of which Man the microcosm has been evolved, to reflect the image of God. The natural sciences may properly be contrasted with the "humanities" by being called the "divinities"; a man has only a one-sided education who has not studied both.

Such a symmetrical education should be provided as a "general course" lying as a foundation for all special courses. Such a course has been crowded out of the college; it must find place in the high school, where it should be nourished and defended, as the fruiting of the common course of the lower grades. The high school is the *people's college*. We should substitute for the old three-legged-stool ideal of education, called the three R's a broad, up-to-date, common, intellectual bond for all mankind. Such a course should consist of equal proportions of six subjects; and the school day should be divided into six equal periods to accommodate them: viz., language, mathematics, manual training, history, geography, and art training (or ethics). Political geography is best studied with history; but geography as "the description of the world" means nature study, or the natural sciences.

Nature always presents itself as a complex unit to be analyzed, and therefore the earlier study of nature should be general and

superficial ; the study of special branches of science begins with the first year of the high school, when physical geography or physiography may be begun, and in the spring the attention may be given to the unfolding vegetation. Next autumn the plant and insect world can be considered in their interrelations. When the leaves fall, comparative anatomy and general physiology, that is, "zoölogy" may be studied, taking up the development of the hen's egg in the spring and making comparison with the developing eggs of the frog and of insects. The third year may be devoted to physics and the fourth to chemistry ; but these sciences have their highest applications in physiology, and the best reason that can be given for their study is that they make it possible for us to understand physiology. Hence I would combine physiology with them. Yet so interrelated are all departments of knowledge that it becomes easy and proper to include natural science in general and biology in particular in much of the work of the other hours of the school day. Under history will be included the biographies of the scientists and the history of science, as well as much of anthropology. Under language will come not only readings in scientific English but also in scientific German. Under art will be included drawings of living models. Under manual training will be included not only writing but school gardening and practical agriculture, also wood working, etc. Even mathematics should be extended to the solution of problems in physics, chemistry, biology, physiology, etc. In this way the student realizes that knowledge is compactly knit together, as an organized unity. And this is the most cogent reason why all men should have a general training. Special training can be offered in various directions, not by exclusion of any one of the six fundamentals, but by varying the proportion between the branches that belong in each. Thus in a classical course, the language hour can be devoted to Greek or Latin rather than to French or German. In the business course, the mathematical hour can be devoted to business arithmetic. In a similar way we can have as many special courses as we desire without narrowing the foundation.



The *Bulletin* of the Torrey Botanical Club for May, contained an article by Professor John W. Harshberger on the water-storing tubers found on *Asparagus Sprengeri*, and on two species of ferns, *Nephrolepis cordifolia* and *N. davallioides*. Fresh tubers were tested microchemically for various food substances; the results indicated that water storage is their principal function.

In this period of too rapid utilization of our forest products it is a relief to hear from the Forest Service that "on the Pacific coast, especially in Oregon and California, there is an immense amount of white fir (*Abies concolor*) timber now going to waste for lack of some commercially profitable means of disposing of it. At present it is very little used for lumber, and since it is not cut to any extent its proportion in the forest tends to increase at the expense of other and more valuable trees. Experiments conducted at the Forest Service laboratory at Washington show that this wood is admirably adapted for the production of paper pulp by the sulphite process. It is also claimed that, so far as the product is concerned, the manufacture of fiber from white fir would be a commercial success and that the fiber produced would find its greatest usefulness in the production of manilas, where great strength is required, and in tissues which need very long fibers. It seems probable, also, that it would make very good newspapers, for which purpose its naturally light color would particularly adapt it.

#### NEWS ITEMS

Mr. David Day Whitney has been appointed instructor in biology at Wesleyan University.

Mr. Harry L. Wieman has been made instructor in biology at the University of Cincinnati.

Professor Frank Lewis Rainey, of Parsons College, Iowa, has been appointed as professor of biology in Central University, Kentucky.

Edward W. Berry, of the Johns Hopkins University, has been appointed American editor for Paleobotany on the *Botanisches Centralblatt*.

Mr. William Bateson, F.R.S., who recently lectured on heredity in this country, has been elected to the chair of biology at Cambridge University.